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A Calibrated Maxey-Eakin Curve for the Fenner Basin of the Eastern Mojave Desert, California

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M.L. Davisson and T.P. Rose: Lawrence Livermore National Laboratory (LLNL)

Metropolitan Water District (MWD) of southern California and Cadiz Inc. investigated the feasibility of storing Colorado River water in groundwater aquifers of the eastern Mojave Desert as a future drought mitigation strategy. This culminated in the public release of the Cadiz Groundwater Storage and Dry-Year Supply Program Draft EIR, which included pilot percolation studies, groundwater modeling, and precipitation/runoff analysis in the Fenner groundwater basin, which overlies the proposed storage site. The project proposes to store and withdrawal Colorado River water over a 50-year period, but will *not* exceed the natural replenishment rates of the groundwater basin. Several independent analyses were conducted to estimate the rates of natural groundwater replenishment to the Fenner Groundwater Basin, which was included in the Draft EIR. The U.S. Geologic Survey, Water Resources Division (WRD) officially submitted comments during public review and concluded that the natural groundwater replenishment rates calculated for the Draft EIR were too high. In the WRD review, they provided a much lower recharge calculation based on a Maxey-Eakin estimation approach. This approach estimates annual precipitation over an entire basin as a function of elevation, followed by calibration against annual recharge rates. Recharge rates are estimated on the basis that some fraction of annual precipitation will recharge, and that fraction will increase with increasing elevation (Maxey and Eakin, 1949). This results in a hypothetical curve relating annual groundwater recharge to annual precipitation (Fig. 1). Field validation of recharge rates is critical in order to establish credibility to any estimate. This is due to the fact that the Maxey-Eakin model is empirical. An empirical model is derived from practical experience rather than basic theory. Therefore, a validated Maxey-Eakin model in one groundwater basin does not translate to a different one. In the WRD's Maxey-Eakin model, they used a curve calibrated against three locations in *western* Nevada and applied it to the Fenner Basin. It is of particular importance to note that all three of the WRD's locations are *west* of longitude 116°W, where annual precipitation is significantly lower (Davisson and Rose, 2000). Therefore, the WRD's Maxey-Eakin curve was calibrated to a drier climate, and its application to the Fenner Basin lacks credibility.

LLNL has developed a calibrated Maxey-Eakin curve for the Fenner Basin validated by four independent field observations (Fig. 1). Recharge rates to these four sites were determined by a hydrologic mass balance method, for which three of the sites have been calibrated to isotopic age dates. Detailed discussions of each calibration point are presented in Davisson and Rose (2000). The LLNL Maxey-Eakin curve predicts at least twice as much annual recharge in Fenner Basin than predicted by the WRD's Maxey-Eakin curve. The differences in the two curves is expected since the Maxey-Eakin model is *empirical* and results will vary significantly between different geographic settings and between different geographic scales. The LLNL curve is calibrated against field observation within project area basin, whereas the WRD's curve was calibrated outside the project area, at a larger scale, and in drier climates north and west of the Fenner Basin.

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Davisson, M.L. and Rose, T.P., 2000, Maxey-Eakin methods for estimating groundwater recharge in the Fenner Watershed, southeastern, California. Lawrence Livermore National Laboratory UCRL-ID-139027, 13 pp.

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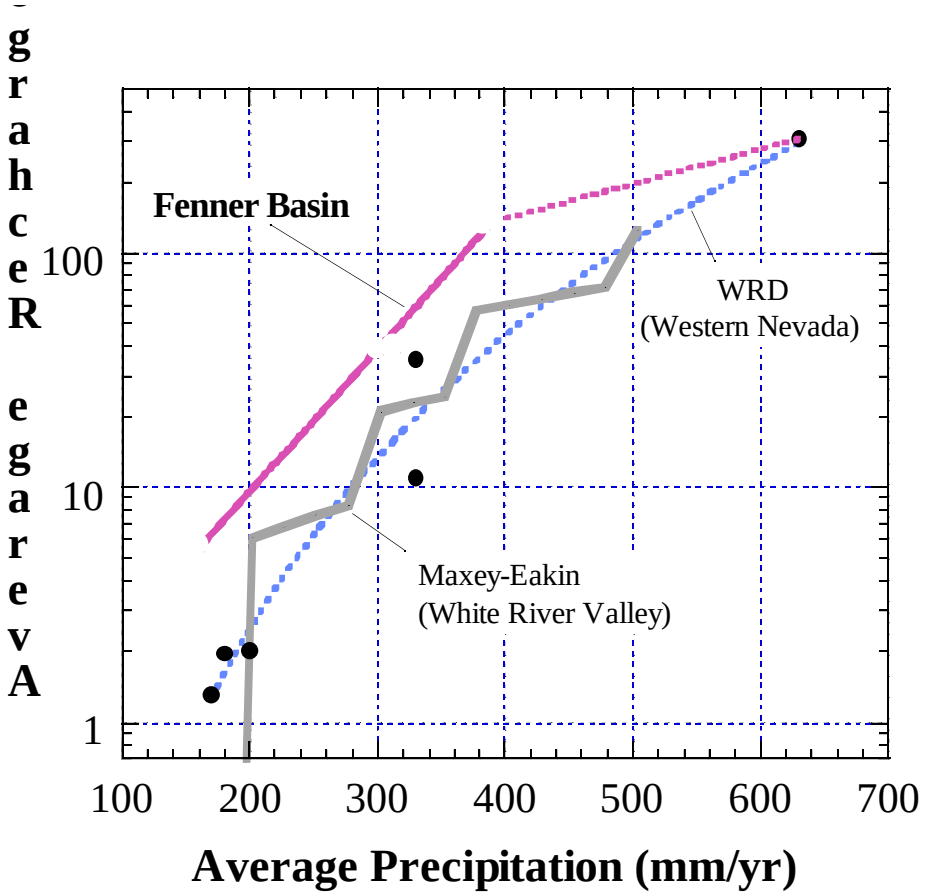

Figure 1. Maxey-Eakin curves used by LLNL, WRD, and Maxey-Eakin's original for the White River Valley, Nevada.